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Indian Standard

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(पहला पुनरीक्षण)

Criteria for Design of Lifting Beams

(First Revision)

ICS 93.160

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Hydraulic Gates and Valves Sectional Committee, WRD 12

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydraulic Gates and Valves Sectional Committee had been approved by the River Valley Division Council.

Lifting beams or lifting frames are used for handling gates stop logs and trash racks. The lifting beams/frames make it possible to engage and disengage the cranes/hoist from the gate or trash-rack under water.

The limit of application (depth of water) of lifting beams frame will be set by the depth to which it is possible for a diver to work if it is required in case of failure of the beam. The lifting beam is operated under balanced condition and with clean grooves. For dirty grooves specially during construction, the use of lifting beam is not recommended because of frequent ramming may structurally damage components of lifting beam.

This Indian Standard was first published in 1992. The first revision of this standard incorporates modifications in design values, pins connecting the lifting beam, lifting hook, side guides, etc. and guide rollers.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*).' The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CRITERIA FOR DESIGN OF LIFTING BEAMS

(First Revision)

1 SCOPE

This standard deals with criteria for design of three types of engaging and disengaging lifting beams.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 GENERAL REQIREMENTS

The design of lifting beams/frames should meet the following general requirements:

a) A design with connection of lifting beam to the gate at single point suspension can be used for small spans provided provision of in-built lateral restraints by way of spindles or pipe/socket, etc. is kept in beam.

b) The spacing between the guide shoes or rollers of the lifting beam/frame should not be less than l/l0th of the span or 500 mm whichever is more.

c) If a lifting frame is used, the height of the frame should not be less than l/12th of span or 1 m whichever is more.

d) To provide greater stability the lifting beams should be equipped with two hoisting ropes or a suitable sling.

e) Spears or pilot rods should be provided on the gate to guide the hook into proper position for grappling and to prevent rotation of the gate when raised above the guides.

f) For storing the lifting beam on the ground, suitable device should be provided so that the hooks are not touching the ground.

4 TYPE OF ENGAGING AND DISENGAGING LIFTING BEAMS

Depending upon the mode of engagement the lifting beams are classified as follows:

a) Manually operated lifting beams;

b) Automatic lifting beams; and

c) Lifting beams with electro-hydraulic drive.

5 MATERIALS

The materials for construction of various components is given in Table 1.

6 MANUALLY OPERATED LIFTING BEAMS

The lifting beam hooks and lifting lugs should be located symmetrically about the central axis and should be in the line of centre of gravity of the gate equipment to be lifted when the lifting beam guide rollers or shoes are engaged in the guides. The lifting beam should be counter to maintain its verticality when suspended (*see* Fig. 1).

7 AUTOMATIC LIFTING BEAMS

7.1 Several types of engaging devices are used for such lifting beams. One of the arrangements which are recommended for use is given in 7.2.

7.2 Pipe and Socket Arrangement

The general arrangement of this type of lifting beams is shown in Fig. 2. The engagement and disengagement of hooks are performed after preliminary loading by hand of the grab device which operates under the action of falling load after receiving a mechanical impulse from a movable stop in the gate/trash rack. For reliable operation the following conditions should be fulfilled while designing the lifting beams:

a) The socket (pipe) in the gate should be made in such a manner that the pipe (socket) in the beam matches freely with it, taking into account the gaps in the grooves, the displacement of the engaging elements in the gate and the possible twisting/deformation of the beam.

b) To prevent the possibility of disengaging the beam from the gate, the beam should be made with a stop device controlled from a movable stop in the gate, which is brought into the operating position only when the gate is placed on the sill or already lowered gate units/sections.

c) To eliminate the possibility of free swinging of the gate with respect to the lifting beam when it is outside the groove the beam cantilevers should have lateral pipe which should enter freely into holes in the gate.

d) The block stem should descend freely by its own weight into the guides within the limits of preset travel.

e) The counterweight of the lever should have sufficient weight to produce the required torque to overcome the frictional forces in the hinges and unforeseen resistance in the coupling.

f) Pins, axles and shafts should be fabricated from corrosion resistant steel. Bush and bearing materials should offer low frictional values.

8 LIFTING BEAMS WITH ELECTROHYDRAULIC DRIVES

General arrangement of this type of lifting beams is shown in Fig. 3. The following important points should be kept in view in designing this type of lifting beams:

a) The hydraulic drive is provided by means of the servomotor. The servomotor should have sufficient capacity.

b) After rotation of the grab to ensure full opening, the oil should be pumped for some time through a safety valve and then a time relay should disconnect the electric motor. The disconnection may also be performed by an operator from the crane based on readings from grab position gauge.

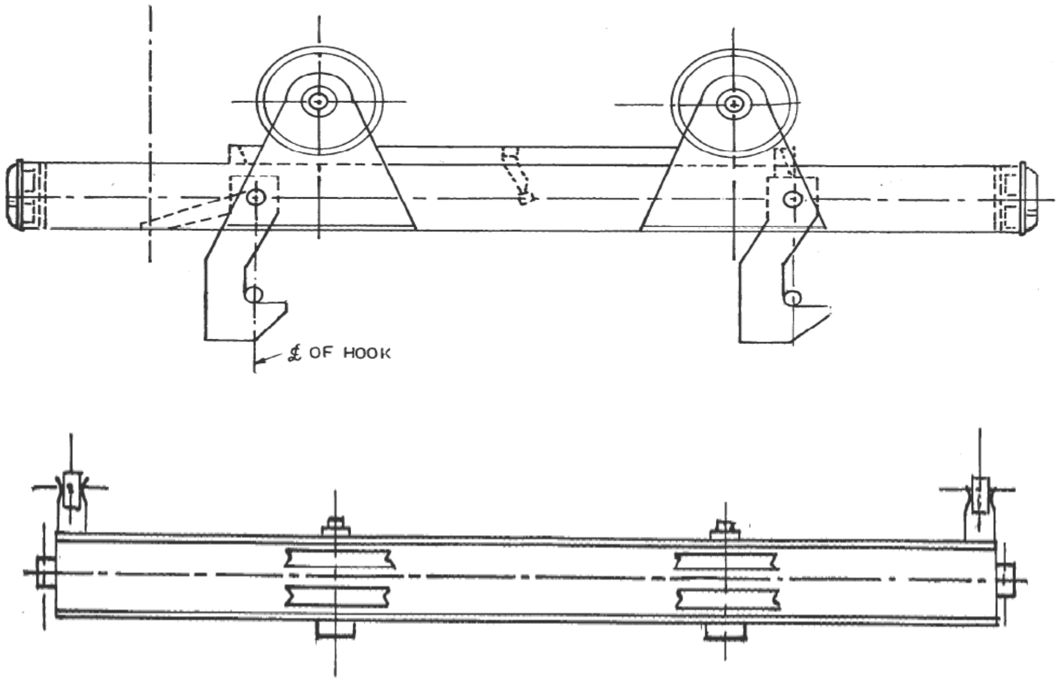

Fig. 1 Typical Details of Manually Operated Lifting Beam

Table 1 Materials for the Components of Lifting Beams

(*Clause* 5)

Sl No.	Component Part	Recommended Materials	Ref. to IS No.
(1)	(2)	(3)	(4)
i)	Lifting beam frame	Structural steel	IS 2062
ii)	Lifting beam hook	a) Forged steel	IS 2004
		b) Structural steel	IS 2062
iii)	Pin	a) Corrosion resistant steel	IS 1570 (Part 5)
		b) Forged steel (Cr plated)	IS 2004
iv)	Bushing	Al. Bronze/Self lubricating bushing	IS 305
v)	Counter weight	Cast iron	IS 210
		Structural steel	IS 2062

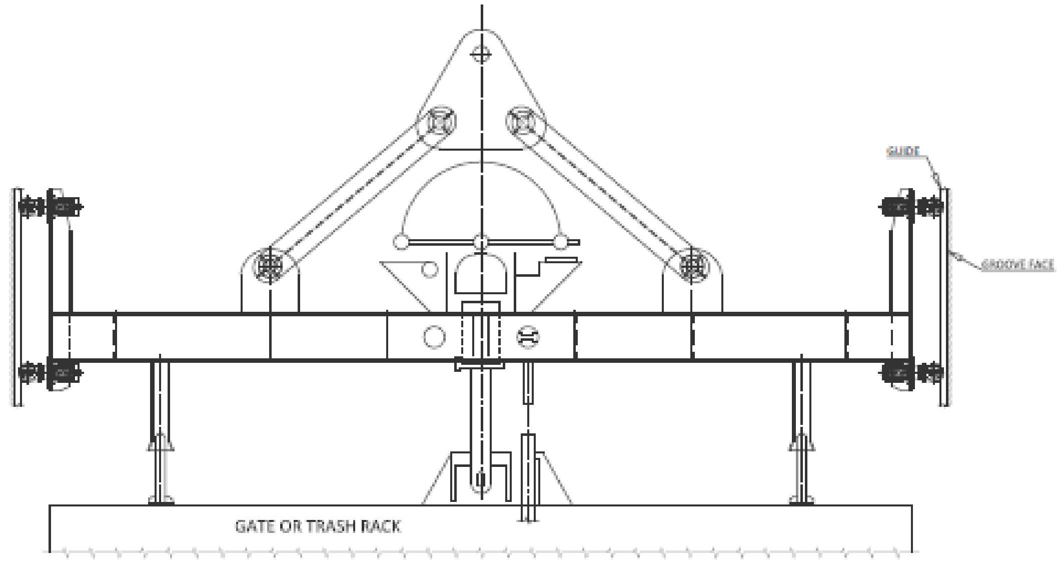

FIG. 2 TYPICAL DETAILS OF AUTOMATIC LIFTING BEAM WITH PIPE AND SOCKET ARRANGEMENT

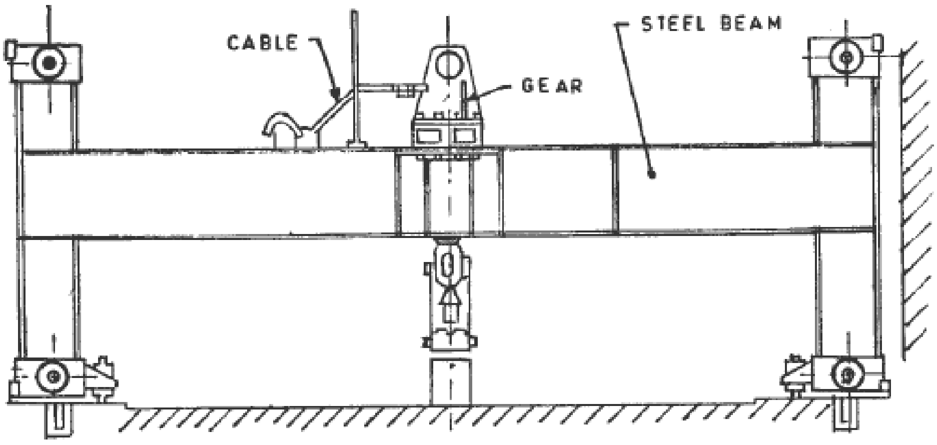

FIG. 3 TYPICAL DETAILS OF LIFTING BEAM ELECTROHYDRAULIC DRIVE

c) A induction type gauge should be kinematically connected to the rotary stem.

d) Two additional induction gauges should be located at the ends of beam steel structure to signal the position of beam with respect to the gate.

e) The cable leadouts should be heremitical sealed.

f) To prevent possible infiltration of water into the frame in the drive end, a compensation chamber should be provided which should be filled with working liquid and separated from the external medium by a rubber diaphragm.

9 DOUBLE HOOK ARRANGEMENT

In this arrangement the pair of lifting hooks on the lifting beam is actuated by a counter-weight on a lever which is the preset in engaging or disengaging position. The movements of the hooks should be actuated by a single counter weights connected suitably to ensure synchronized operation. Four types with typical arrangements are given in Fig. 4 to 7.

10 DESIGN

10.1 Lifting beams should be designed for the capacity of the beam or the gantry crane, whichever is higher with impact factor of 1.32. The permissible stresses should be limited to the values given below:

a) *Structural Steel*

1) Direct compression and compression in bending	0.55 YP
2) Direct tension and tension in bending	0.55 YP

3) Shear stress	0.40 YP
4) Combined stress	0.75 YP
5) Bearing stress	0.75 YP

b) *Brass or Bronze*

1) Direct bearing stress	0.04 UTS

10.2 Pins Connecting the Lifting Beam, Lifting Hook, Side Guide, Etc.

The pins should be of rolled/forged steel, be used for lifting beam with a factor of safety of 5. Deflection of frame or the structure as a whole (without considering impact factor) should be limited to span/800. The pins connecting the lifting beam, lifting hook, side guide rollers etc. shall be of corrosion resistant steel conforming to IS 1570 (Part V).

10.3 Design of Hook

The hooks are made out of plate steel and should be designed as curved beam. The stress will be limited to that in lifting frame. At the engaging point the profile is to be hard faced to a maximum of 10 mm depth machined smoothly for uniform bearing of pin. In case the thickness of the hooks required more than the plate thickness the plates may be joined with rivet and welded.

10.4 Guide Rollers

The guide rollers/shoes should be provided on the sides of lifting beam to suit the gate groove to limit lateral movement of gate to not more than 6 mm in either direction. The roller should be adjustable and travel on the guide tracks. Care should be taken that centre of gravity of the lifting hook should coincide with centre of gravity of gate, so that no lateral twist is permitted while lifting the gates. Each guide roller shall be designed for 5 percent of the hanging loads (weight of gate + lifting beam).

10.5 Counter Weight

Suitable counter weight in the form of dead weight should be added to lifting beam for self balance. The balance of lifting beam should be checked on the shop floor before using the lifting beam for operation in the vents.

10.6 Equipment Required for Handling Lifting Beams

The hoisting equipment used for lifting beams, such as gantry crane, underslung hoist, etc. should be designed with fully balanced bottom blocks suitable for connecting the lifting beams. No lateral twist should be permitted while engaging the hooks. Before connecting the gate balancing of lifting beams should be tested preferably in dry condition.

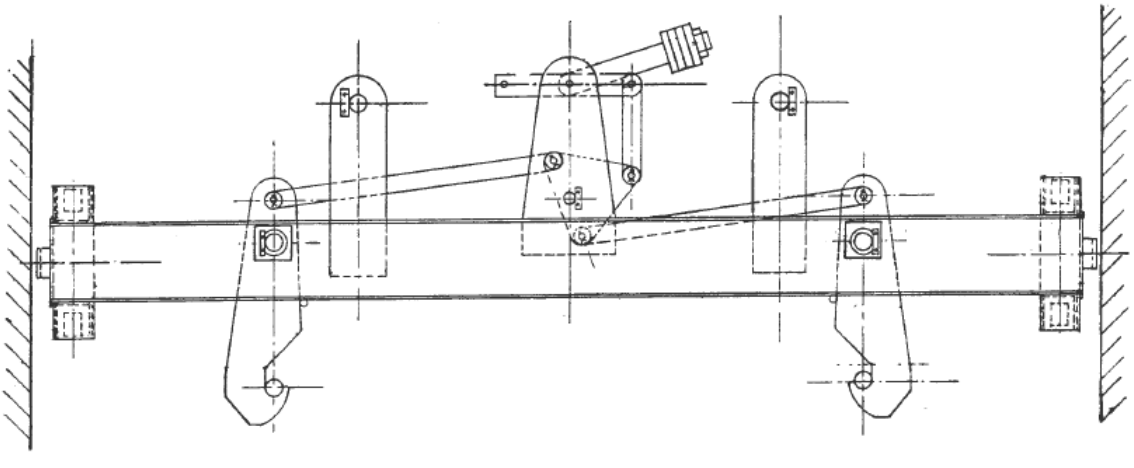

Fig. 4 Typical Details of Lifting Beam Arrangement with Two Interlinking Automatic Engaging and Disengaging Hooks — First Method

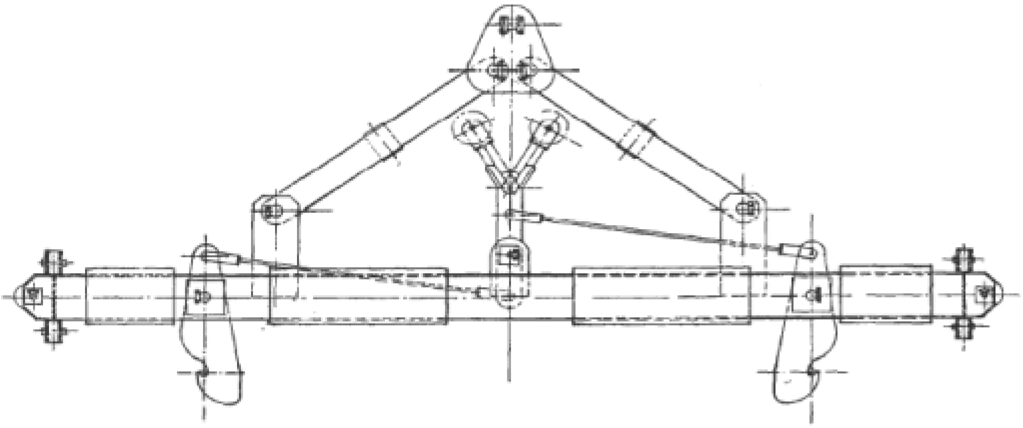

FIG. 5 TYPICAL DETAILS OF LIFTING BEAM ARRANGEMENT WITH TWO INTERLINKING AUTOMATIC ENGAGING AND DISENGAGING HOOKS — SECOND METHOD

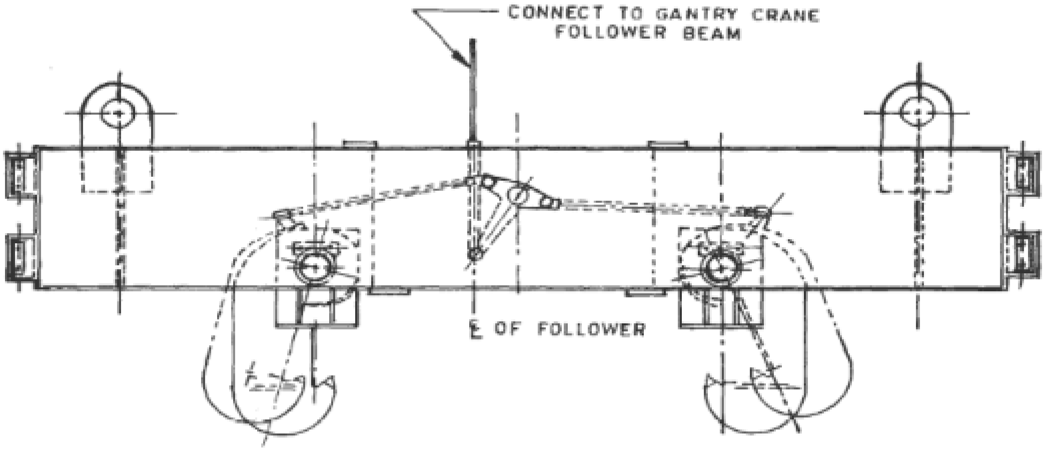

FIG. 6 TYPICAL ARRANGEMENT OF LIFTING BEAM OPERATED FROM GANTRY CRANE WITH DOUBLE HOOK ARRANGEMENT

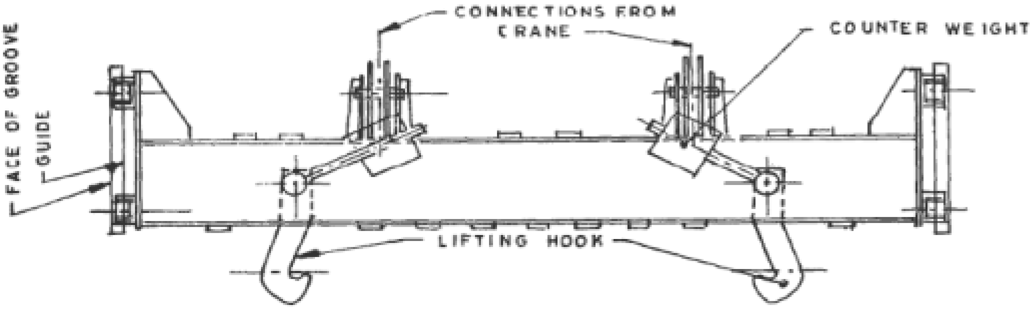

FIG. 7 TYPICAL LIFTING BEAM WITH TWO INDEPENDENT COUNTERWEIGHTS WITH DOUBLE HOOK ARRANGEMENT

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
210 : 2009	Grey iron castings — Specification (*fifth revision*)
305:1981	Carbon steel forgings for general engineering purposes — specification (*third revision*)
1570 (Part 5) : 1985	Schedules for wrought steels: Part 5 Stainless and heat-resisting steels (*second revision*)
2004 : 1991	Carbon steel forgings for general engineering purposes — specification (*third revision*)
2062 : 2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)

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Amendments Issued Since Publication

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